Uncertainty Quantification for Production Navier-Stokes Solvers, Phase I

Completed Technology Project (2010 - 2010)

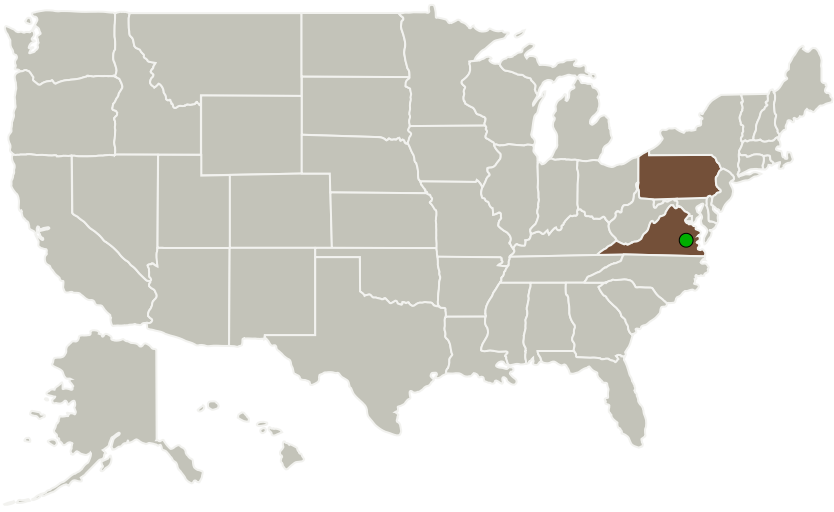
Project Introduction

Solution errors are inherent in any Computational Fluid Dynamics (CFD) simulation. Systematic identification, reduction, and control of these various error sources is crucial if the results of CFD simulations are to be trusted for design and performance assessment of air vehicles. While grid refinement studies may verify the spatial accuracy of a solution, these studies are generally laborious and time intensive. Continued development of a standalone Error Transport Equation (ETE) solver is proposed. The proposed program exploits an existing mesh adaptation and error quantification package, CRISP CFD

REG

, which currently interfaces with meshes and solutions from the NASA unstructured Navier-Stokes solvers FUN3D and USM3D. The Phase I effort will explore the use of ETE methodology with these production Navier-Stokes solvers as well as the popular structured grid code OVERFLOW. Improvements in error prediction for aerodynamic coefficients will be sought. In addition, the proposed program will address uncertainty quantification for turbulence models commonly used in computational aerodynamics applications. The ETE solver provides a promising, viable path for reliable error quantification and solution verification. This tool will provide numerical error bars, quantifiable levels of uncertainty in both local and globally integrated variables, for use in computational aerodynamics and other applications.

Primary U.S. Work Locations and Key Partners



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Small Business Innovation Research/Small Business Tech Transfer

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Organizations Performing Work	Role	Type	Location
CRAFT Tech - Combustion Research and Flow Technology	Lead Organization	Industry	Pipersville, Pennsylvania
Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

Primary U.S. Work Locations	
Pennsylvania	Virginia

Project Transitions

January 2010: Project Start

July 2010: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/139940)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

CRAFT Tech - Combustion Research and Flow Technology

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

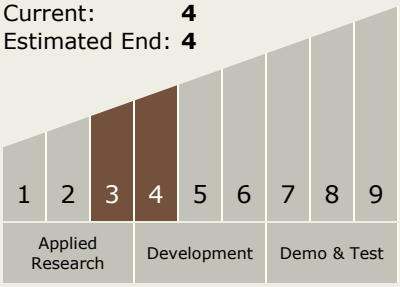
Carlos Torrez

Principal Investigator:

Peter Cavallo

Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **4**



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Technology Areas

Primary:

- TX11 Software, Modeling, Simulation, and Information Processing
  - TX11.3 Simulation
    - TX11.3.6 Uncertainty Quantification and Nondeterministic Simulation Methods

Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System